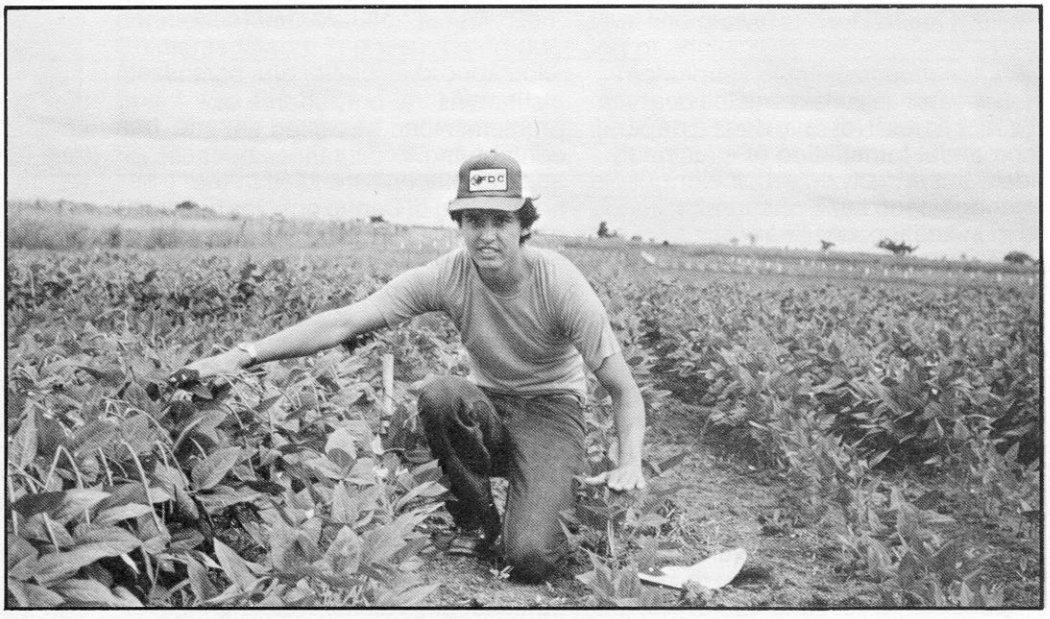
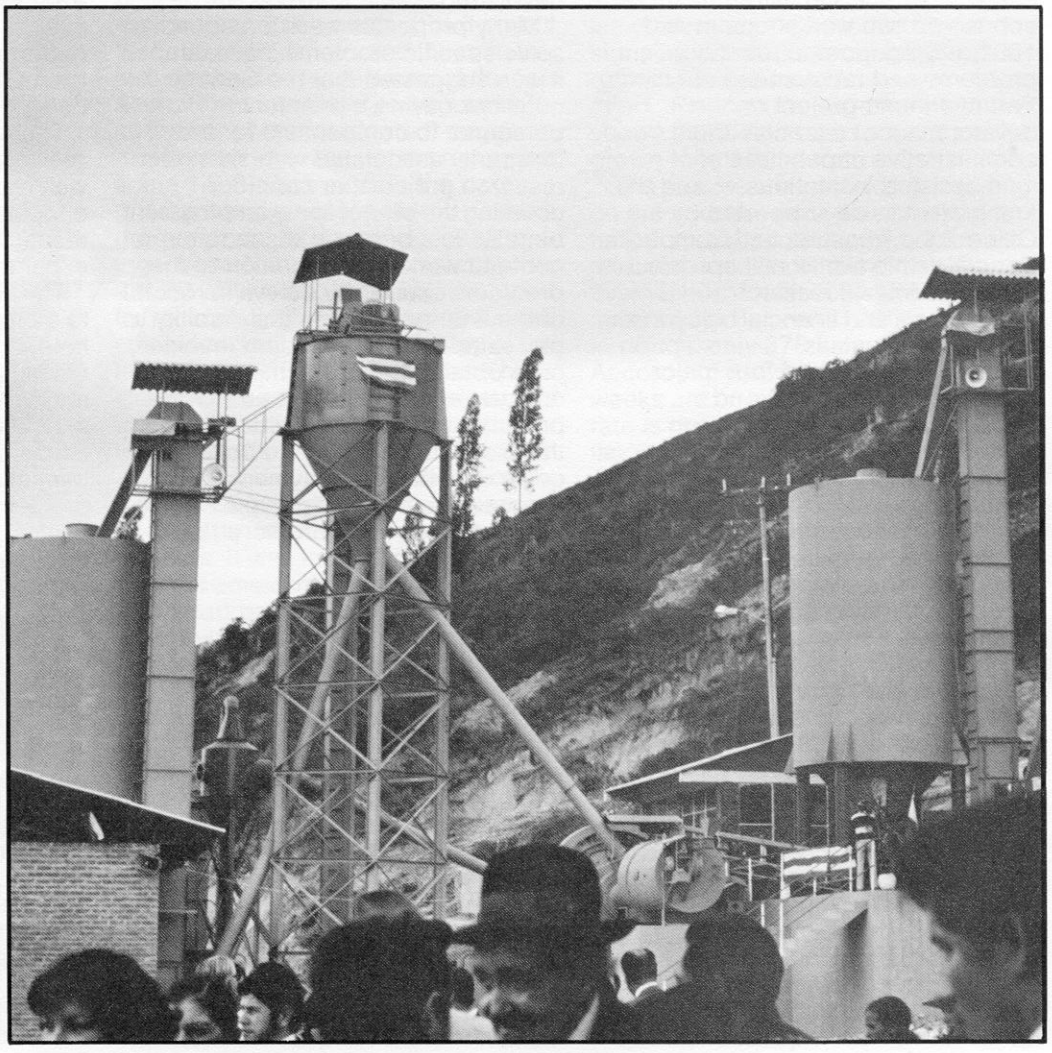
FERTILIZER'S ROCKY ROAD

JACQUELINE A. ASHBY





When Humberto García, a small farmer in Colombia, went to buy the fertilizer that he was planning to use for planting in the wet season of 1980, the fertilizer distributors in the nearby market town had run out of the product he usually applies. One fertilizer dealer did have a newly arrived product, *fosforita huila,* or ground phosphate rock from the nearby Huila phosphate mine. Since this new product was cheaper than the alternative fertilizers, Humberto García took two bags back to his farm to try.

Humberto García got a pleasant surprise. His crops grew well, and it had cost him only about one-half of what he normally spends on this kind of fertilizer. In the near future, researchers expect to remove the surprise — but keep the low-cost gains — for smallholders using phosphate fertilizers in Latin America.

In July 1977, IDRC provided financial support to assist the International Fertilizer Development Centre (IFDC), based in Muscle Shoals, Alabama (U.S.A.), in developing a phosphate strategy for the acid infertile soils of tropical Latin America. The International Centre for Tropical Agriculture (CIAT) was interested in joining IFDC in conducting the phosphorus studies.

The timing seemed to be right for such a study. Growth in agricultural output in the Latin American countries in the past two decades has depended to a large extent on increased use of fertilizer. In Colombia, for example, consumption of phosphate fertilizer had increased about 300 percent in that period. Fertilizer prices were high and projected to be higher. An estimated one billion hectares in Latin America having some potential commercial value are deficient in phosphorus.

At the same time, new rock phosphate deposits for exploitation were being discovered, including some 20 deposits in several countries of tropical Latin America. The potentially lower price of locally produced phosphate rock would expand the possibilities for increased use of fertilizer in food production on phosphorus-deficient soils. In Colombia, for example, Huila phosphate rock retails at U.S. $109 per tonne compared with the most widely used complex fertilizer at U.S. $420 per tonne. Since many staple food crops in Latin America are produced on small farms, and almost all Latin American countries are net importers of food staples, the availability of lower cost phosphate fertilizers should benefit both small-scale producers and urban consumers in Latin America. This potential for improvement exists in both food crop production and pasture for beef and dairy production, important contributors to the diet of Latin America's rapidly increasing urban population.

But the usefulness of rock phosphates is not limited to Latin America. "Essentially anywhere you have high rainfall conditions, where leaching of the soil has taken place over time, you get a tendency for the base (nonacid) elements to be leached out. The soils tend to become acidic and infertile, and there rock phosphate has great potential for restoring a measure of fertility at a low cost," says Dr William D. Bishop, Director of IFDC's Agro-Economic Division. "If you are looking at the importance of a particular nutrient to production in a region, then phosphorus in Latin America is an absolute *must*. It's critical," says Dr Bishop.

Most of the phosphate fertilizers used today are derived from phosphate rock, but are expensive because of the costly commercial processes that are used to increase solubility. This increased solubility makes it possible for a high percentage of the phosphorus contained in the fertilizer to be immediately dissolved by soil moisture and, therefore, be immediately available to the crops being fertilized. Although acid soils are normally considered a detriment to optimum crop production, it was felt that the high acidity present in the majority of Latin American soils could be taken advantage of by using the soil itself to dissolve locally available phosphate rock rather than increasing solubility through a commercial process.

While direct application of finely ground phosphate rock has been practiced in many countries throughout the years, little was known in 1977 about the suitability of the phosphate-containing rocks located in Latin America.

If rock phosphate is to have a benefit, says Dr Bishop, all the various production factors must be taken into consideration. "You have to know what the phosphorus content of the local rock is. Just like any other ore, rock phosphate can contain low or high concentrations of what you want as the end product. You need to know what crops you will be applying it on, under what sort of soil conditions you are working. And you have to know what crop response there will be, because if the crop doesn't respond well to the particular type of phosphate, I don't care if rock phosphate *is* cheaper, it's still not a good buy for the farmer."

The effectiveness of phosphate rock as a fertilizer varies according to the extent of solubility or "reactivity" of the part of the rock containing the phosphorus. Phosphate rocks from the various newly discovered deposits in Latin America vary in chemical composition. Some are more soluble than others. Therefore, the first tasks of the researchers were to determine the solubility of these various phosphate rock sources and to investigate how each one reacts in different types of soil.

Dramatic yield increases are common with most crops when more soluble forms of conventional phosphate fertilizers are used on many soils of tropical Latin America. The project's research on various types of these soils has also shown promising results with the use of finely ground phosphate rock for a number of soil-crop combinations, using a total of 12 different rock sources from Latin America.

The residual availability of phosphorus from phosphate rock and other phosphate fertilizers has also been evaluated in the project. Results show that commercially processed fertilizers make large amounts of phosphorus available to the plant over the short term, but because of the continuous process of dissolving in the soil, the phosphate rock provides an excellent source of long-term available phosphorus. This characteristic is especially important for pasture production, and phosphate rock can now be recommended without reservation for upgrading vast areas of low-quality grazing land in Latin America.

The project's research also shows that phosphate rock is effective on many acid soils for crops with a higher phosphorus requirement than pasture grasses, such as beans, cassava, and rice. Fertilization of annual crops with relatively high rates of phosphate rock could even be followed by establishment of pasture grasses to use the residual phosphorus without a reapplication.

Field experiments are also investigating factors such as the effectiveness of phosphate rock on crops or pastures when it is combined with a more soluble phosphate fertilizer. The findings indicate that it is possible for farmers to reduce the cost of correcting a phosphorus deficiency by substituting the cheaper phosphate rock for some proportion of the expensive soluble phosphate fertilizer.

The research is testing a variety of flexible strategies for managing locally available phosphate rock sources alone and in combination with other phosphate sources. The results will provide a comprehensive guide to the utilization of potential phosphate sources, soil, crop, and management combinations in which phosphate rock presents an effective alternative to higher-cost soluble phosphates in the acid infertile soils of Latin America.

NEW DIRECTIONS

Agronomic studies in the phosphorus project have provided basic information on the agronomic potential of indigenous phosphate rock in the acid soils of tropical Latin America, information that was lacking when the project began in 1977. In order to transfer these promising experimental station results to national extension programs and to farmers like Humberto García, some additional questions must be answered.

How effective will phosphate rock fertilizers be when support fertilization, weed and insect control, or irrigation are managed under the constraints faced by farmers? Substitution of phosphate rock products for conventional phosphorus sources, mixtures of the two, or modified phosphate ores are expected to reduce costs, but the economic information that fertilizer producers and farmers need in order to choose from these possibilities has yet to be tabulated.

Differences in the physical and chemical properties of phosphate rock indicate that farmers may have to change their customary methods of handling and applying fertilizer when they use phosphate rock. The implications of these changes for fertilizer management in different cropping systems in Latin America and their acceptability to farmers must still be evaluated.

With research addressing these questions, it will be possible to make recommendations to fertilizer producers, to national extension programs, and to farmers about how they can best realize the agronomic potential that the project's research has identified for new phosphate rock products.

"One of the things we expect from a cheap, local, effective source of phosphate is an increased demand for the fertilizer. And from that demand and increased use, you would create an increased supply of food," says Dr Bishop. □

Photos opposite page Top: Cowpeas respond to the application of rock phosphate in an experimental plot. Bottom: A newly-opened rock phosphate grinding facility in Colombia: putting it back in the ground for better yields.

Jacqueline A. Ashby is a rural sociologist in the Agro-Economic Division of IFDC.